

# TECHNICAL MEMORANDUM

Utah Coal Regulatory Program



July 5, 2006

TO: Internal File

THRU: Wayne Hedberg, Permit Supervisor, Task Manager



FROM: Peter H. Hess, Environmental Scientist/Engineering, Team Lead



RE: 2005 Midterm Permit Review, Canyon Fuel Company, LLC., Dugout Canyon Mine, C/007/039, Task ID #2528

## SUMMARY:

The Division initiated a midterm permit review of the Dugout Canyon Mine mining and reclamation plan / permit on October 13, 2005. That Task was identified as Task ID #2348 within the Division for record keeping purposes.

The Division identified numerous deficiencies within the approved mining and reclamation plan. Those deficiencies were forwarded to the Permittee on January 4, 2006.

The Permittee responded to the deficiencies on May 19, 2006. The Division has identified the review of that response as Task ID #2528.

This technical memo will address the adequacy of the Permittee's responses to deficiencies aired in the engineering requirements of the R645 Coal Mining Rules.

## TECHNICAL ANALYSIS:

## OPERATION PLAN

## EXISTING STRUCTURES:

Regulatory Reference: 30 CFR 784.12; R645-301-526.

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**Analysis:**

Section 526.100, Mine Structures and Facilities, (Volume 3, Chapter 5, page 5-32) refers to Section 521.100, which in turn states that two “existing structures” are present within the permit area which were presumably ‘used in connection with or to facilitate coal mining and reclamation operations for which construction began prior to January 21, 1981, (R645-100-200). These are the existing County road and a UP&L power distribution line.’

The description of the location of the existing County road within the permit area is provided in **Section 521.100** of the mining and reclamation plan.

The Pace Canyon road is noted in the 1980 Carbon County Road Maintenance agreement with the BLM. The Pace Canyon road is considered a “public” road until it enters the NE1/4SE1/4 of section 25, T13SR12E. At this point, the road is gated and public access is no longer possible. The gate is located on the extreme NW corner of section 25, thence it crosses onto surface managed by the USDOJ / BLM / SLO. The road continues up through BLM surface (through the Pace Canyon facility) where it crosses over to Thayn private surface, just past the Pace Canyon fan portal disturbed area.

The Pace Canyon County road has been in existence for many years, and thus, a reference should be made in Section 526.100, Mine Structures and Facilities.

Plates 4-1 and 5-2 depict the location of the existing UP&L distribution line that was improved and activated to provide electrical service to the Mine. The distribution line is owned and maintained by UP&L.

A deficiency aired by the Division in the January 4, 2006 response stated that relative to **R645-301-526, and 521.100**, the Permittee needed to modify the statement on Chapter 5, page 5-32 to include a reference to the Pace Canyon County road as a pre-existing structure.

The Task ID #2528 response received on May 19, 2006 contains a revised page 5-34 which makes the following statement:

“The road in Pace Canyon is a pre-existing road, the exact date of construction is unknown, however it is shown on the USGS Pine Canyon 7 ½ minute quad map dated 1972”.

This addresses the deficiency aired under R645-301-526, and 521.100.

**Findings:**

The minimum regulatory requirements of this section of the R645 Coal Mining Rules have been met.

**SUBSIDENCE CONTROL PLAN**

Regulatory Reference: 30 CFR 784.20, 817.121, 817.122; R645-301-521, -301-525, -301-724.

**Analysis:**

**Renewable Resources Survey**

Renewable resource lands within the permit and adjacent areas are shown on Plate 4-1 and are discussed in Section 411 of the M&RP. The surface area where subsidence is predicted is used for livestock grazing and wildlife habitat, with limited timber production on adjacent lands to the east of Dugout Canyon (See Section 411.120). Hydrologic resources in this area are discussed in Chapter 7 of the MRP.

**Subsidence Control Plan**

Subsidence Control Measures

Subsidence control measures are discussed in Volume 3, Chapter 5, page 5-28 of the approved mining and reclamation plan. As stated in the text, "anticipated" areas of subsidence are depicted on Plate 5-7, PROPOSED MINE SEQUENCE AND PLANNED SUBSIDENCE BOUNDARY. The depicted subsidence boundary was determined by using a thirty-degree angle of draw, as required under R645-301-525.542. The text states that the actual angle of draw is anticipated to be less based upon results of mining and subsidence (studies, PHH) in the general area. It is generally accepted that angles of draw in Utah mines vary from 15 to 22 degrees, but can reach 28 degrees in some geologic areas. Therefore, the thirty-degree angle is justified in determining the area of influence where secondary coal extraction can affect surface areas.

Plate 5-7 also depicts areas where the area of potential subsidence impact could actually occur outside of the approved permit area. This is depicted in Section 17, T13S, R13E of State of Utah SITLA lease ML-48435. An area of potential influence is also mentioned relative to Federal lease U7064-027821.

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A review of the subsidence monitoring report for 2004 reveals that the entire report consists of a Plate depicting the Gilson seam workings, the locations of the various subsidence monitoring points, and the elevation differences at each monitored point. **There is no discussion included which analyzes the submitted information.**

One of the deficiencies aired in the Task ID #2348 response stated, “**there is no analysis included relative to the angle of draw study** which was conducted over the area between 1<sup>st</sup> West and West Mains, (secondary coal extraction occurred during 2001 in the Rock Canyon seam). **The Permittee must analyze and submit a determination for the angle of draw for the study in this area, or state where that analysis can be found.**”

The response received on May 19, 2006 (Task ID #2528) contains **APPENDIX 5-11**, which has been prepared by Maleki Technologies, Inc., Consulting Mining and Geotechnical Engineers, of Spokane, Washington. Page 11, paragraph one, section **3.3 Subsidence Parameters**, of the MTI report states the following; “Table 2 (also on page 11) summarizes estimates for the angle of draw and the subsidence factor for selected Utah operations, (including the Dugout Canyon Mine). CFC measurement of the angle of draw using a series of monuments installed over a line to the south of RC1 panel (figure 2) **has been inconclusive and influenced by ground uplift; a common subsidence feature in rugged topographies of the Book Cliffs Coal Field.** USBM has reported measurements in the range of 23 degrees to 30 degrees over the Price River Coal (Fejes 1986) and East Mountain (1991). Considering all available data from Utah, an average angle of draw of 30 degrees is prudent and conservative.”

The Task ID #2528 response also contains a revised Plate 5-7, Proposed Mine Sequence and Planned Subsidence Boundary, which indicates that the angle of draw determination study conducted over the Rock Canyon #1 panel, (RC-1) was inconclusive based on analysis of data collected over a four year period.

The Permittee has thus addressed the deficiency aired in the DOGM Task ID #2348 document.

The Division did not feel that a single angle-of-draw determination could be determined as being adequate throughout a mine’s life of operation. Therefore, **the Division requested that the Permittee propose a frequency to determine whether various angles of draw exist within the Mine’s permit area.** The collected data can be used to determine the angle of draw that has the most influence within the permit area. This will be useful in predicting affects and areas of impact for future mining.

Appendix 5-11 has determined that a 30-degree angle of draw is prudent for determining areas of potential subsidence damage above and / or adjacent to extracted longwall panels. Thus,

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there is no need for the Division to amend the applicable angle of draw for the Dugout Canyon Mine, as mentioned in R645-301-525.541.

There is no need for the Permittee to propose a frequency for determining whether different angles of draw (for different stratigraphic sections) may occur within the Dugout Canyon Mine permit area, unless the Permittee feels a need to vary from the 30-degree angle of draw used in the preparation of Appendix 5-11.

Plate 5-7 depicts areas where 500-foot barrier pillars are left between longwall panels, as well as areas where the only abutment remaining between the panels consists of the chain pillars left by the development of the gate roads. The Permittee has initiated the leaving of these 500-foot barrier pillars for the purpose of ground control and to minimize sudden energy releases (bounces, or coal bursts) at the longwall face. This has been done to provide an additional measure of protection for CFC underground employees. There was no mention of these 500-foot barriers anywhere in section **525, Subsidence**.

The Permittee's response (Task ID #2528) received on May 19, 2006 addresses the use of abutment-abutment pillars for controlling ground movement adjacent to the GIL 1 tailgate, (See APPENDIX 5-11, page 11, section **3.4 Gate Pillar Behavior**, paragraph two). Canyon Fuel Company expects these pillars "to behave elastically based on underground observations in the GIL 1 tailgate. Site specific calculations are forth coming".

The Division requires that the Permittee submit these site-specific calculations when they become available in accordance with the requirements of R645-301-525.440.

Paragraph one of section **3.4 Gate Pillar Behavior**, (See page 11, APPENDIX 5-11) briefly discusses the affects of gate road pillar designs on the subsidence trough over a retreating long wall panel. The MTI report states that in general, "based upon a comprehensive case study by the USBM in 1991, Dyni showed that the narrow 30-foot wide **yield** pillars commonly used in the two-entry Utah reserves crushed completely with no influence (or subsidence humps) above the gate roads. This is in general agreement with measurements over the long wall panels in the Price River coal and detailed underground measurements at the RC Seam confirming that the "gate pillars crushed behind the face (Malecki and others 2003)".

Based upon the information submitted within APPENDIX 5-11, it was not clear if the Permittee uses the narrow 30-foot wide yield pillars or two-entry development in the Gilson seam at the Dugout Canyon Mine.

A review of the map provided as part of the 2005 subsidence report for the Dugout Canyon Mine reveals that long wall panels GIL 2 and GIL 3 were developed using the two entry

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gate road development with the thirty foot wide pillars (50 foot center width) separating the two entries. The GIL-4 and GIL-4A panels will be developed using the same design.

As can be seen from the same map, barrier pillars are left on an as needed basis as determined by the Mine's planning department. Face widths have been increased to approximately 875 feet. Therefore, the discussion of the affects that the 30 foot width by 120 foot length gate road pillars have on the subsidence trough over the long wall panel is appropriate to meet the concerns of the Division. The yield pillars are designed to crush and are doing what they have been designed to do.

The Division's Task ID #2348 deficiency response contained a requirement that the Permittee needed to provide a discussion relative to the affects of the gate road chain pillars to the tension/compression zones of the subsidence trough. As noted above, the 30 foot wide by 120 foot long chain pillars used in the two entry development system at the Dugout Canyon Mine are designed to crush, and are doing so as the long wall advances outby their location. The pillars are being crushed, as they are within the tension zone. Therefore, the pillars are being affected, as they are in the "bending (tension) area", and thus have little affect on the tension / compression zone. It is not necessary for the Permittee to address this requirement.

The Division's Task ID #2348 deficiency response contained a requirement that the Permittee needed to provide a discussion that elaborates on what considerations the mining engineer implements to minimize surface impacts from these abutments throughout the mining area. This should including a discussion relative to longwall panel orientation versus surface features requiring protection, as well as sub-critical, critical, and supercritical panel width considerations.

APPENDIX 5-11, section **4.0 PREDICTED GROUND MOVEMENTS**, page 14, contains a discussion of the methodology used to develop the mine design in order to minimize surface deformation at the Dugout Canyon Mine. As noted in paragraph three of section **4.1 Methodology**, Maleki Technologies, Inc., "used a three-dimensional influence function method while accounting for site-specific conditions using the subsidence monitoring data from both the Rock Canyon and Gilson seams. These methods have become very popular for the prediction of subsidence and surface strains within the last two decades (USBM, 1983; Peng and others 1994; SDPS 2000). They are superior to graphical methods because they can be used to model an entire longwall block while allowing an examination of the sensitivity of results to variations in seam thickness, pillar designs, panel dimensions and overburden thickness".

APPENDIX 5-11, section **4.2 Results**, page 14 refers one to Figure 6, which depicts surface subsidence profiles in an analyzed area of the Gilson Block 2, which has only seen development mining as of the date of this technical memo. The first developed long wall panel which will be extracted in the Gilson Block 2 area will be the GIL-5 (or Gilson seam, 5<sup>th</sup> panel).

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MTI's three dimensional influence function method of modeling predicts a maximum amount of subsidence over GIL-5 ranging from 1.7 feet to 1.9 feet, depending upon the amount of overburden. Naturally, where deeper cover prevails, the amount of surface settling will be less.

Figure 7 predicts tensile strains in the two sections analyzed for four panels in the Gilson Block 2 area. The MTI report states "horizontal strain patterns have been presented while accounting for variations in topography and mining conditions. Figure 7 clearly shows final compression within the center of the panels and tension near barrier pillars". "Surface strains are generally higher at lower elevations. This indicates a greater potential for localized fracturing over an area of more shallow cover." "...calculated strains do not reach levels that can cause surface fractures".

The Malecki report states on page 15 that "the panel and barrier designs which have been adopted for the Gilson Block 2 area for ground control and safety limit surface deformation and potential fracturing".

Section **2.0 SUBSIDENCE MECHANISM**, page 6 of the MTI report contains a discussion of the three subsidence phases associated with trough subsidence, and elaborates on the sub-critical, critical and super-critical phases which overburden reacts to as coal is extracted from beneath it. All troughs react on the lateral axis of the extraction area, as well as the longitudinal axis.

Page 6 of the MTI report states the following; "in the Gilson Block 2, CFC is utilizing panel-barrier designs to control overburden caving, seismicity and surface deformation (MTI 2005). Considering panel width to average overburden depth ratios for the project area (0.4 to 1.0), these long wall panels **are considered to have sub-critical widths, and thus the great majority of subsidence is expected during the mining of individual long wall panels. The subsidence process is expected to be mature within 2 years after mining**".

It must be realized that the MTI report is a "general" report for a "general" area using "general" conditions, such as depth of cover, constant geologic member thicknesses / member strengths, with virtually little or no consideration made for thinning members, faults, or other geologic conditions which are virtually unpredictable. Unseen conditions are impossible to predict, and the affect that they may have on subsidence within a specific area may not be predictable until the impacts are observed.

As noted on Page 6 of the MTI report, "subsidence characteristics for any coal field depends on site-specific conditions and mining practices, including strata competence, geologic structure, topography, extraction height, extraction speed, and mine designs. The site specific subsidence parameters for the Gilson study area were addressed using local and regional monitoring results within Utah coal fields".

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Based upon this reviewers limited geotechnical knowledge, it is felt that the report "Prediction of Surface Deformation Resulting from Longwall Mining Over the Gilson North-East Block" addresses the minimum regulatory requirements of **R645-301-525**.

### Subsidence Monitoring

Subsidence monitoring is discussed in Volume 3, Chapter 5, pages 5-28 through 5-30 of the Dugout Canyon Mine MRP. The plan discusses the installation methods for the various survey control points located throughout the permit area. The currently approved plan requires one monitoring point per longwall panel. These are monitored once a year, for new areas that have undergone coal extraction. All survey points are checked during this single evaluation. The 2004 field survey for the annual subsidence report was completed by Mr. Bruce T.S. Ware of Ware Surveying and Engineering on August 27, 2004.

The submitted data contains the surface elevation at each monitoring point when the station was installed, as well as the surface elevation at that point when the 2004 annual survey was conducted. Interim elevation changes by year are not reported.

Although one monitoring point per panel is approved by the current plan, there is no justification provided by the Permittee as to why it is felt that continued monitoring of the maximum amount of subsidence is necessary. Monitoring points are generally located inside of the tension/compression zone, but vary in location from these locations, up to and including the center of the longwall face.

The Division feels that the monitoring of the tension / compression zone, and its lengths which parallel the gate roads are of more importance than the continued monitoring of the maximum depth of the subsidence trough. The Division bases this need upon the fact that subsidence impacts are more likely to propagate to the surface in these tension /compression areas such that they are visible, and capable of affecting soil resources, surface water flows, or create hazards for wildlife or human beings.

Page 5-29, paragraph four states "subsidence monitoring will be carried out on an annual basis, and will entail direct ground surveys and visual surveys of the permit area. The annual subsidence monument survey conducted of the monument elevations is considered to be the direct ground survey. However, visual surveys of the permit area are probably not being conducted, as no report of same has been received by the Division or submitted within the annual report.

**The Permittee must submit a document describing the visual surveys that have been conducted for each monitoring year, beginning with the 2005 evaluation year. This**

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document must contain information relative to areas surrounding monitored seeps, springs, streams, or any other surface activities, **(as approved on Page 5-29, Chapter 5, paragraph 4, Dugout Canyon Mine MRP)**. In addition, roads used to access hydrologic monitoring stations will be visually evaluated during monitoring activities. **The Division recommends that road-monitoring locations be permanently established such that a written record evaluating each location can be maintained.** That record will be submitted as part of the annual subsidence monitoring report.

Page 5-30 of the currently approved Mine plan states the following; "in addition to ground surveys, aerial photogrammetric methods will be included in the surveys when the areas become too large to feasibly handle with ground surveys. This method may be added to enhance the ground surveys...". Visual checks for subsidence will be made during all surface activities, especially during water monitoring activities."

A review of PLATE 6-4, ROCK CANYON SEAM OVERBURDEN THICKNESS, which was last revised in December of 2003, depicts overburden depths ranging over the Rock Canyon seam varying from 800 to 2200 feet. The Gilson seam, which is the seam being actively mined varies from 30 to 60 feet below that (See PLATE 6-5, bringing total overburden depth for the seam being mined from 860 to almost 2250 feet. As can be seen from the map, Location of Methane Drainage Wells (with respect to their associated longwall panels, see Degasification Wells submittals) the design of barrier pillar abutments between adjacent long wall panels is imperative in order to minimize coal bursts and maximize employee safety.

PLATE 6-4 is adequate as far as describing the amount of overburden over the Rock Canyon seam. Due to the fact that all current mining is occurring in the Gilson seam, which varies from 30 to 60 feet deeper than the Rock Canyon seam, the Permittee should provide an overburden thickness map for the Gilson seam, in accordance with the requirement of R645-301-525.430.

Surface lands above the Dugout Canyon Mine are generally covered with vegetation and soils, compared to the SUFCO Mine. At SUFCO, surface cracks are easily visible as the Castlegate sandstone is exposed at the surface. At Dugout, the Castlegate is covered with soils and vegetation. Any cracks that are visible at the Dugout Mine are going to have to be within the Castlegate itself, be very wide, or have a great deal of displacement.

The Division's Task ID #2348 deficiency response required that the Permittee design a **method to monitor subsidence cracks in the tension/compression zone that parallels the gate road entries outlining consecutively mined longwall panels. This must include a method of establishing the location of the tension zone, the method of observation, the method of recording, and the method of reporting significant cracks to the Division.** The

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Division feels that a significant crack is one in which soil resources could be lost, surface flows could be impacted, or persons or wildlife could be injured.

The Malecki Technologies Report contained in APPENDIX 5-11 of the Task ID #2348 response states the following:

- 1) The annual monitoring of in place subsidence monuments at the approved installation rate of one monitoring point per panel is adequate.
- 2) That the Malecki group feels that visual inspection over deeper mines is deemed sufficient, (See Page 17, section **5.0 MONITORING PROGRAM**). The survey data include crack location, orientation, horizontal length, and width.... Malecki Technologies recommends a limited monitoring program so that the presence of surface cracks can be verified.

Therefore, based upon the Malecki recommendation, and the fact that surface cracking has to date been minimal, the Division feels that the currently approved subsidence crack monitoring plan is adequate, as long as the Permittee continues to meet the reporting requirements stipulated within that plan.

### Notification

Plate 5-7 depicts the "PROPOSED" MINE SEQUENCE AND PLANNED SUBSIDENCE BOUNDARY that shows the anticipated dates when development and secondary coal extraction will occur in specific areas of the coal reserve through 2008. Surface topography of the permit area is also depicted, as are coal leases.

The Task ID #2348 deficiency response recommended that the Permittee should consider submitting the mining projection map **with appropriate surface ownership delineations** to ensure that surface landowners are notified at least six months prior to the Permittee crossing into the reserve beneath their land in accordance with the requirements of R645-301-525.700.

The Task ID #2528 response received on May 19, 2006 contains a revised PLATE 5-7 that depicts the planned development and extraction periods through 2010. The anticipated potential subsidence boundary is depicted at an approximate 30-degree angle of draw. The approved mine permit boundary, and all surface ownerships involved with the current Dugout Mine permit area are also depicted.

PLATE 5-7 is P.E. certified by Mr. David G. Spillman, Manager of Technical Services for the Permittee.

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Revised PLATE 5-7, if properly used by the Permittee, has the pertinent information in place that is needed to ensure that the requirements of **R645-301-525.700, Public Notice of Proposed Mining**, are met. PLATE 5-7 must be resubmitted whenever a planned sequence change is made by the Permittee to the underground workings for whatever reason.

The Task ID #2348 deficiency response contained remarks relative to the currently approved subsidence-monitoring plan. Page 5-29 (Chapter 5, Volume 2 of the Dugout Canyon Mine MRP) states that visual surveys of the permit area are to be conducted on an annual basis. However, no documentation of these visual surveys had ever been submitted with the annual report. The Division concluded that these surveys were not being conducted in accordance with the approved plan, based upon the fact that no information had ever been submitted. The Permittee was required to submit written documentation describing the visual surveys that were conducted for each monitoring year, beginning with the 2005 evaluation year.

The annual report for 2005 (received March 14, 2006 at the DOGM) contained the annual subsidence monitoring report for 2005, which contained six pages of surface monitoring information. In the six pages of monitoring information received, the Permittee indicated that virtually no effects of mining related subsidence were visible. The areas inspected included surface along Pace Creek, access roads to surface water monitoring sites, and degasification well locations. Thus, the Permittee has adequately met this requirement of the subsidence-monitoring program for the 2005 subsidence-monitoring year.

The Division's Task ID #2348 List of Deficiencies indicated that it was necessary for the Permittee to justify why the currently approved plan, which allows for one subsidence monitoring point per longwall panel, and the associated annual monitoring of this one point per panel was still felt to be necessary. As one can determine by reviewing APPENDIX 5-11 which has been prepared by Malecki Technologies, Inc., Consulting Mining and Geotechnical Engineers, the majority of the subsidence monitoring data obtained, and the associated ground control techniques developed from this information has been obtained from monitoring in the Rock Canyon seam, which is more shallow than the seam which is currently being mined. As can be seen from FIGURE 2, 2004 DUGOUT CANYON SUBSIDENCE MONITORING STATIONS, only one longwall panel had been completely extracted from the Gilson Block 1 of the Dugout Canyon Mine.

Page 6 of the Malecki report discusses the three phases of subsidence that surface areas go through during secondary coal extraction utilizing long wall mining techniques. The center of the panel (or basin, as settling occurs) is where the *subcritical phase* will first report data, and the rate of settling once the faces passes outby this monitoring point. Once the *subcritical phase* is completed, the strata immediately progresses through the *critical phase*, when the maximum amount of subsidence will occur from the extraction of the associated coal seam. The *supercritical phase* occurs as adjacent panels are extracted and the pillars supporting the gate

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roads are crushed out such that the trough is relatively flat bottomed until an abutment is reached.

As the Permittee is now extracting a deeper coal seam (the Gilson), the continued installation and monitoring of the single monitoring point per panel is justified in providing monitoring data for the deeper seam conditions, which will in turn provide information for the development of better ground control techniques. It will also provide data to confirm that the designs used for the gate road pillar designs and barrier pillars are adequate or inadequate in controlling heavy cover. This is imperative to ensure the safety of the mine workers.

**Findings:**

The Permittee's response to the deficiencies aired under R645-301-525.400 is adequate and addresses the minimum regulatory requirements of that section.

**RECOMMENDATIONS:**

The Permittee's responses (Task ID #2528) to the deficiencies aired within the Division's midterm permit review of the Dugout Canyon Mine MRP (Task ID #2348) are adequate and meet the minimum regulatory requirements of the R645 Coal Mining Rules.

The Permittee should receive a conditional approval of the submitted information. Final approval can be granted upon the receipt of the appropriate number of clean copies for incorporation purposes.